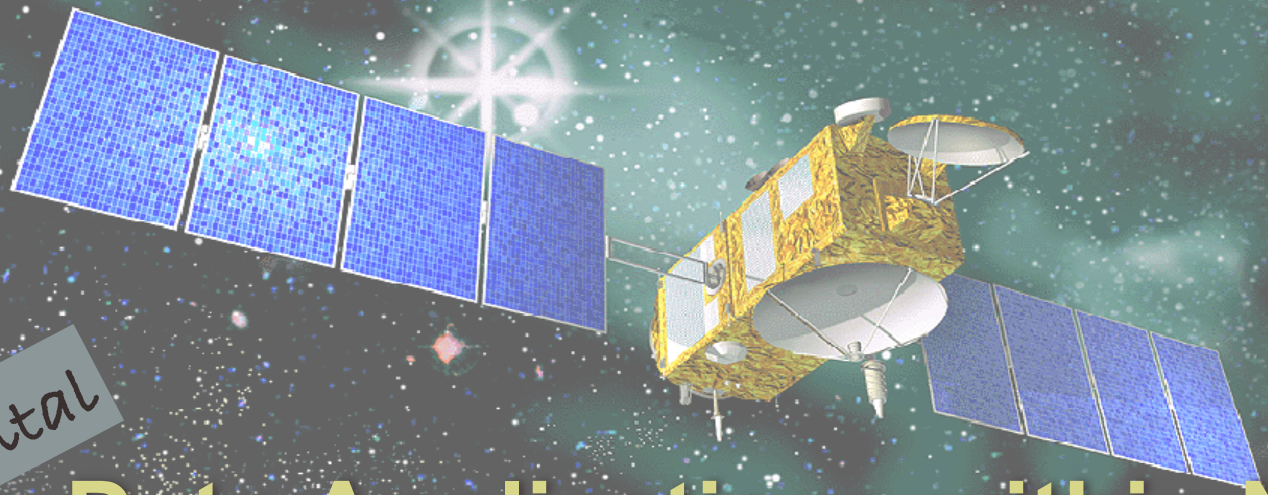


Environmental Satellite Data Applications within NMFS

Cara Wilson

NOAA/NMFS/SWFSC

Environmental Research Division (ERD)

(formerly PFEL)

Integrating Satellite Data Products into Ecosystem-Based Management of Living Marine Resources

MBARI, Moss Landing, CA, May 3-5, 2006

Acknowledgments

Special thanks to

Stan Wilson and John Pereira (NESDIS)

and

NOAA's Satellite Research & Operations (R&O) transition project

NMFS-Satellite group

- Established Jan 2005
- Satellite POCs for each science center (appointed by lab director)

AFSC	Jeff Napp (Seattle)
NEFSC	Jay O'Reilly (Narragansett)
NWFSC	Bill Peterson (Newport)
PIFSC	Jeff Polovina (Honolulu)
SEFSC	Tom Leming (Mississippi)
SWFSC	Cara Wilson (Pacific Grove)
ST	Kenric Osgood (Silver Spring)

POC also a CoastWatch PI

Labs outside of the regional HQ laboratory

The NMFS 'Road Tour' Schedule

NOAA Fisheries and Satellite Data –
Where are we and where are we going?

AFSC	Seattle, WA	Jun 7, 2005
SWFSC	* La Jolla, CA	Jun 15, 2005
PIFSC	Honolulu, HI	Jul 18, 2005
SEFSC	* Miami, FL	Jul 26, 2005
NEFSC	Narragansett, RI	Aug 2, 2005
NWFSC	Newport, OR	Aug 16, 2005
AFSC	* Juneau, AK	Jan 31, 2006
NEFSC	* Woods Hole, MA	Mar 10, 2006
NMFS HQ	Silver Spring, MD	Mar 13, 2006
NESDIS HQ	Silver Spring, MD	Mar 14, 2006
SWFSC	* Santa Cruz, CA	May ?, 2006

* NMFS Satellite POC not at this lab

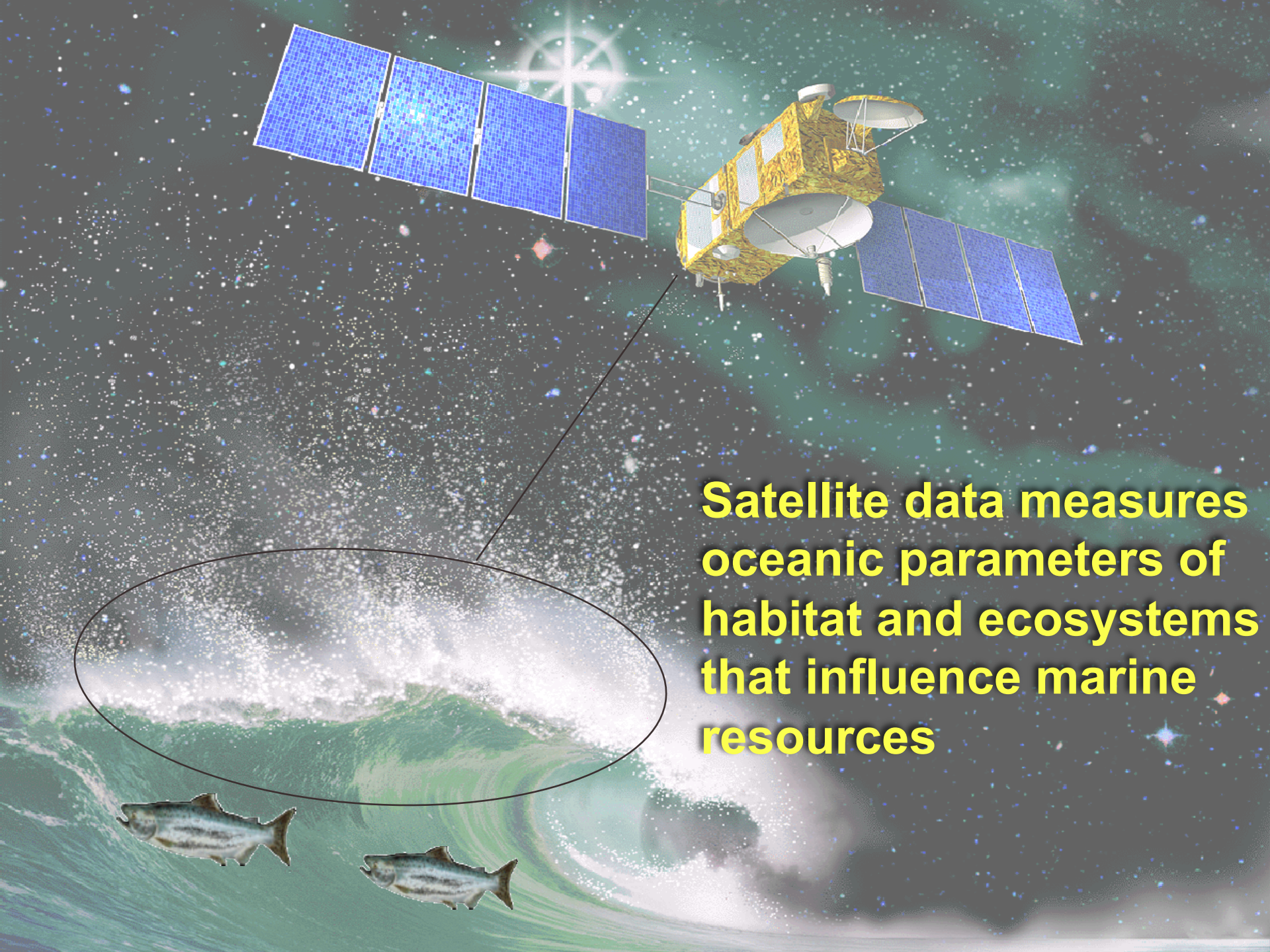
Outline

- Examples of satellite data usage with fisheries
- Some history

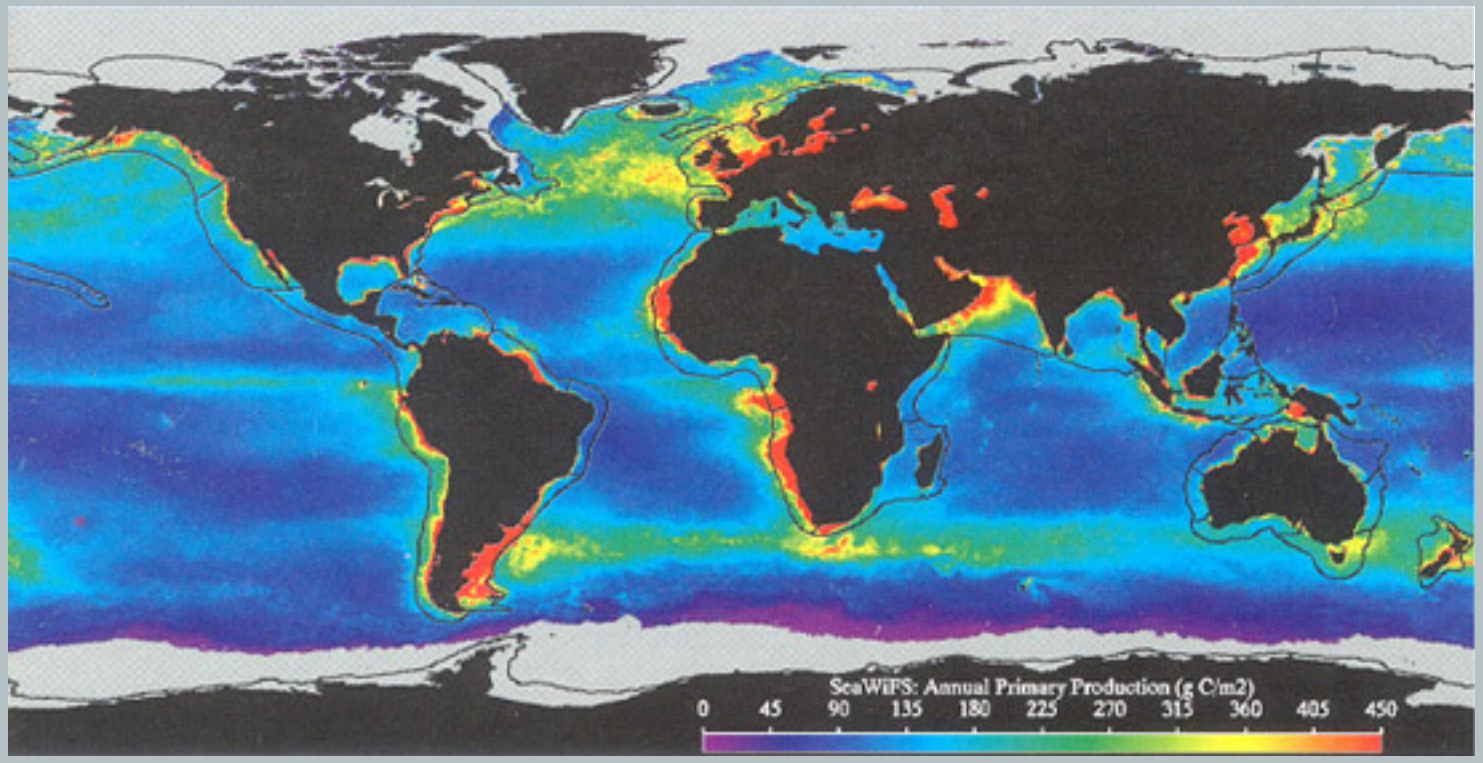
Ultimate Ecosystem

from presentation by Jack Dunnigan, former Ecosystem Goal Team Lead


Satellite data can NOT directly measure populations of fish, lobsters, whales, turtles, etc.

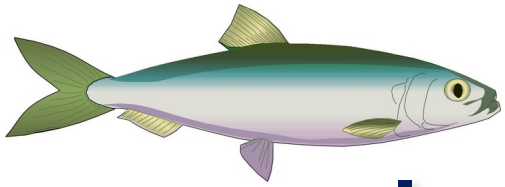

Satellite data measures oceanic parameters of habitat and ecosystems that influence marine resources

Large Marine Ecosystems



Annual satellite-derived Primary Productivity and the outlines of the 64 defined LMEs

Sherman et al., MEPS, 2005 *NOAA/NMFS/NEFSC*



Ocean Features Important to Ecosystems

- Ocean ‘fronts’, boundaries, ‘edges’
- River plumes
- Coastal regions
- Mesoscale circulation patterns: eddies, meanders, ‘loops’
- Convergence zones
- Subsurface thermal structure: MLD, thermocline
- Ocean surface winds
- Ocean currents
- Wave heights

Most of these ocean features can not be adequately resolved without satellite data

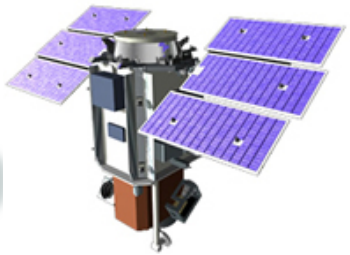
Temporal Events Important to Ecosystems

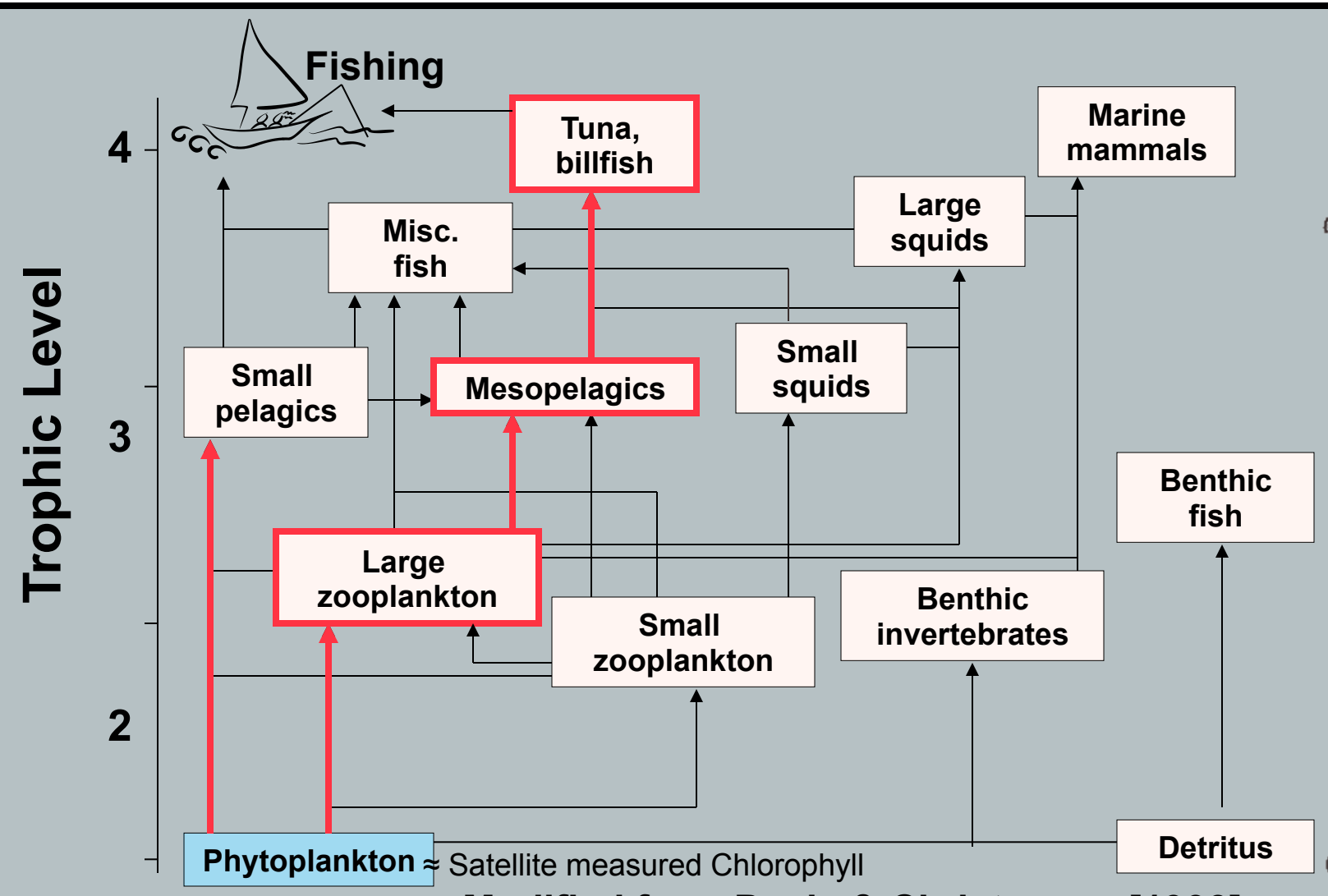
- Upwelling
- Harmful Algae Blooms (HABs)
- Oil Spills
- Seasonal Transitions
- El Niño events
- Regime Shifts (i.e. PDO)
- Global Climate Change

Climate change can affect the timing and/or intensity of many of these processes

Climate Data Records (CDRs) of satellite measurements need to be maintained!

Oceanic Food Web





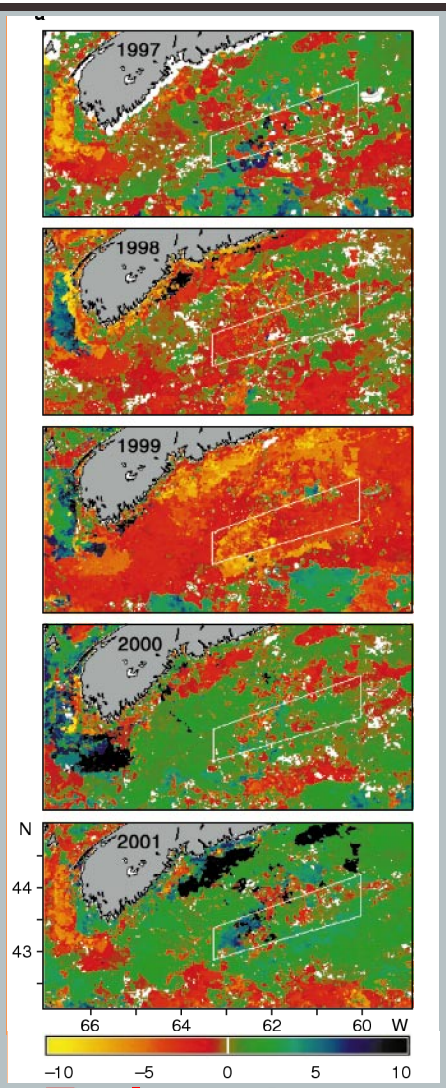
Modified from Pauly & Christensen [1993]

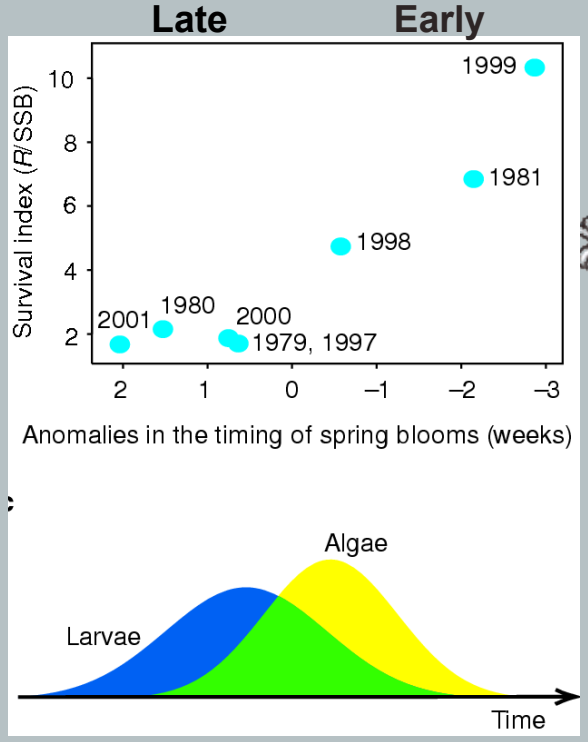
Timing of the Spring bloom and Haddock Survival

(Melanogrammus aeglefinus)

Test of the match-mismatch hypothesis

Annual anomaly in the timing of the spring bloom based on SeaWiFS chlorophyll data





Earlier bloom means more time in the 'green' zone

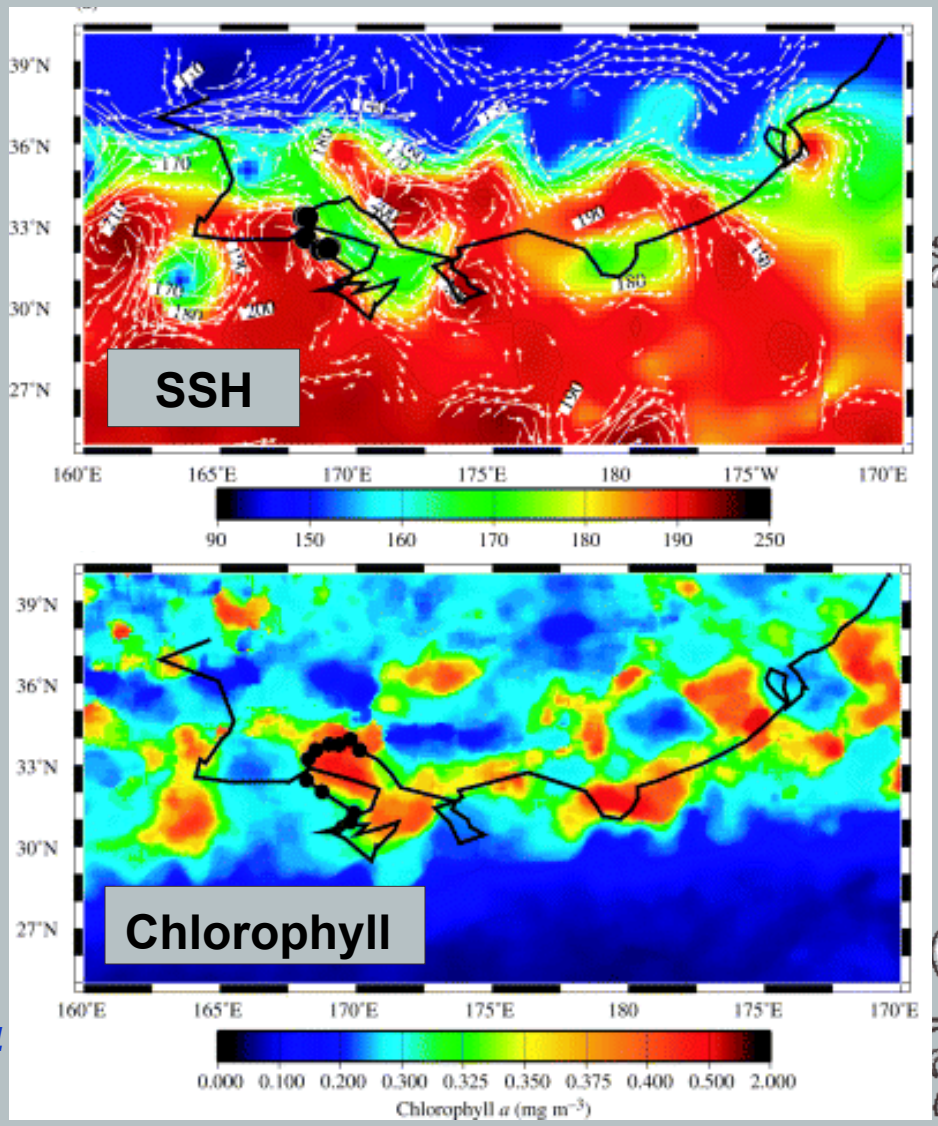
From Platt et al., Nature, 2003

Characterizing Habitat

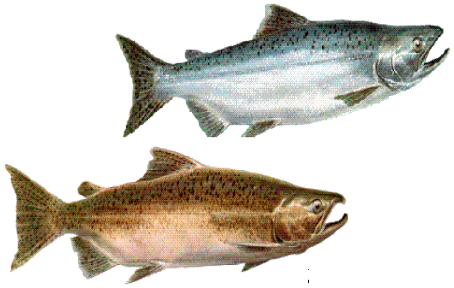
Loggerhead turtle tracks along the Transitional Zone Chlorophyll Front (TZCF) in the N. Pacific during Feb. ‘01

The TZCF is an important foraging ground for a number of commercial and protected species.

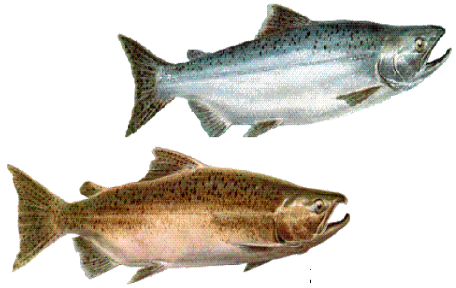
Interannual variability in its location has been tied to the reproductive success of endangered monk seal pups.



Polovina et al., Fish. Ocean., 2004
NOAA/NMFS/PIFSC

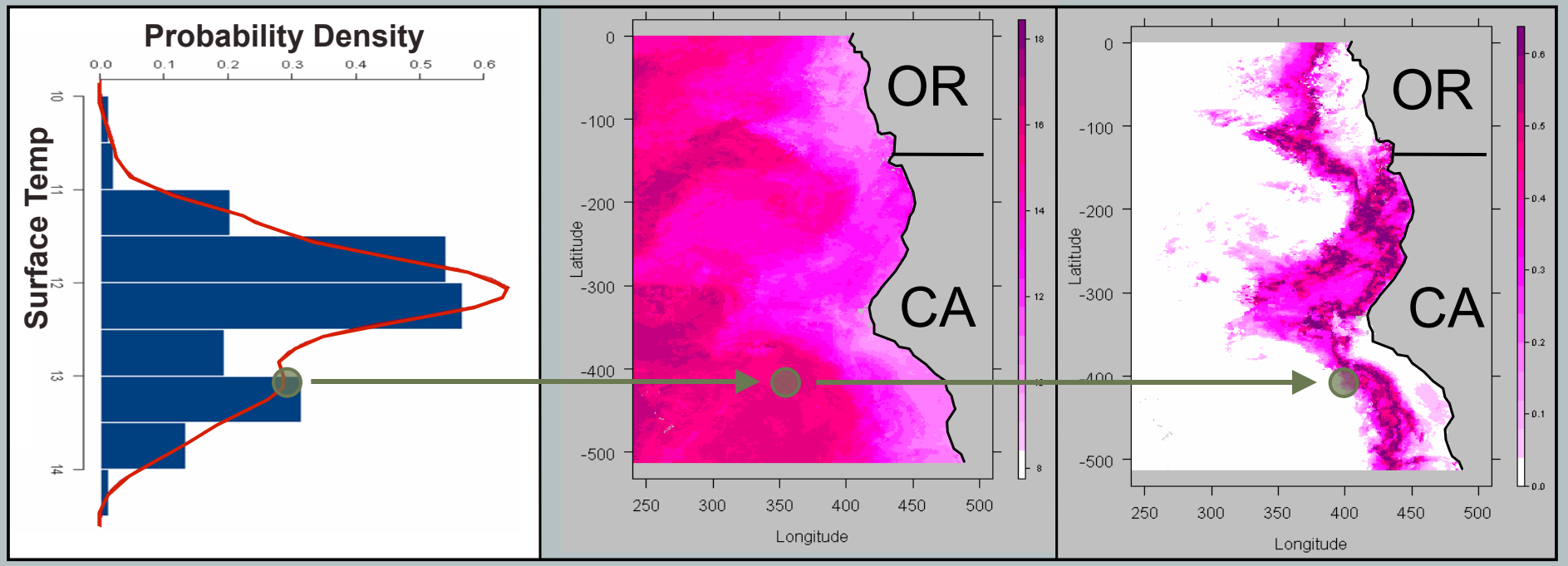


Defining Salmon Ocean Habitat



Chinook Potential Habitat

(Oncorhynchus tshawytscha)

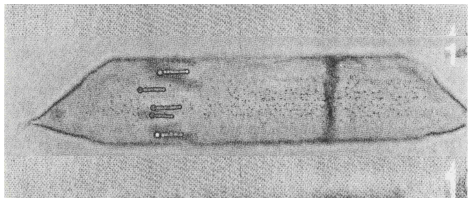


Density of fish's temperature experience at the surface from tag data

Satellite SST

"Contours of utilization" – likely fish location

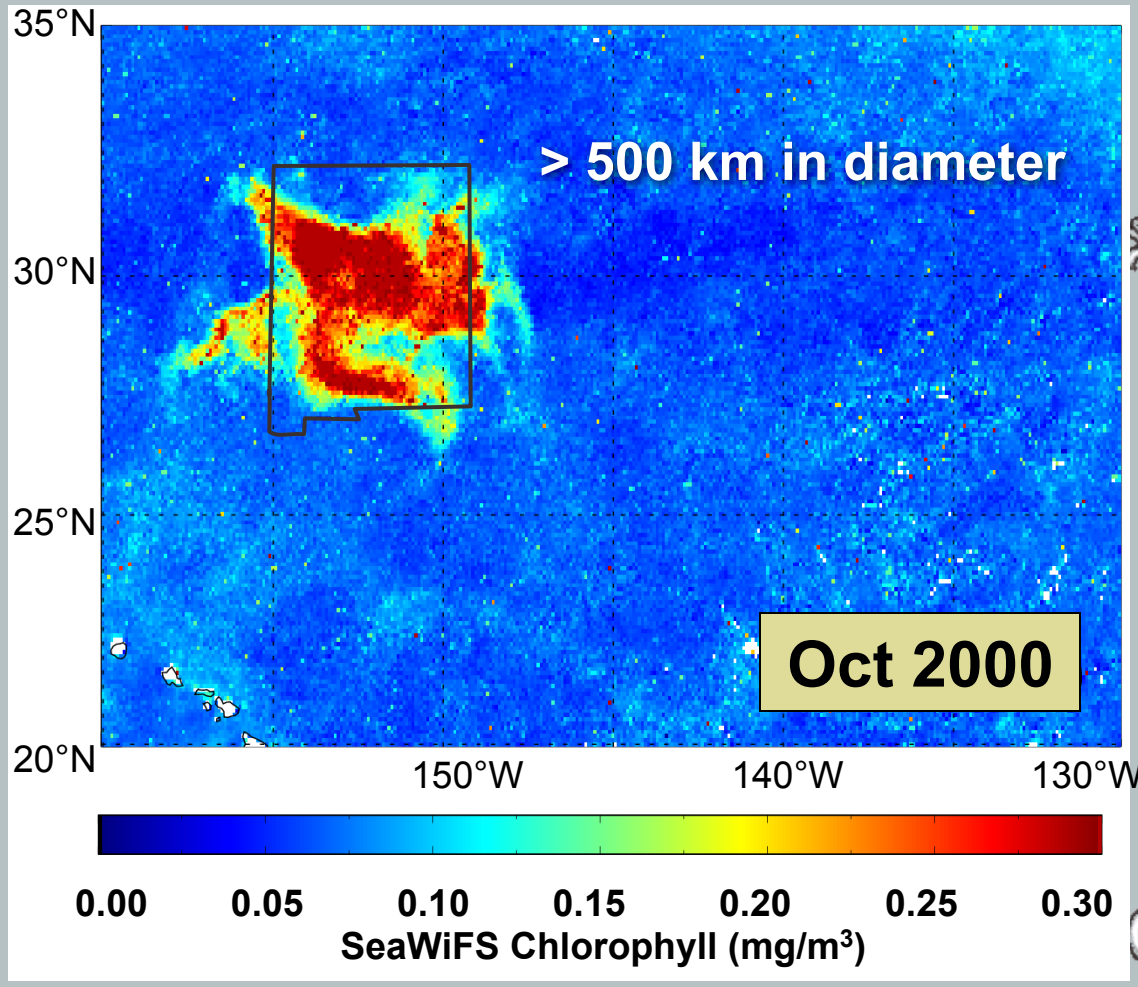
Hinke et al., MEPS, 2005 *NOAA/NMFS/SWFSC*



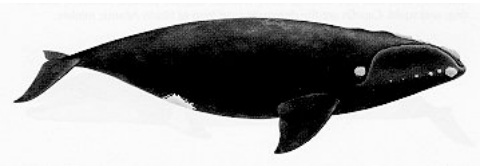
Discovering Habitat?

Large recurrent chlorophyll blooms discovered with satellite data in the middle of the oligotrophic Pacific gyre.

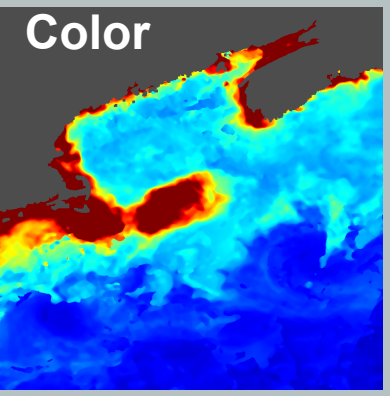
The blooms occur within the target area of several fisheries, including albacore and swordfish, but their impact on higher trophic levels is not known.



Wilson, GRL, 2003 NOAA/NMFS/SWFSC



Right Whale Forecast



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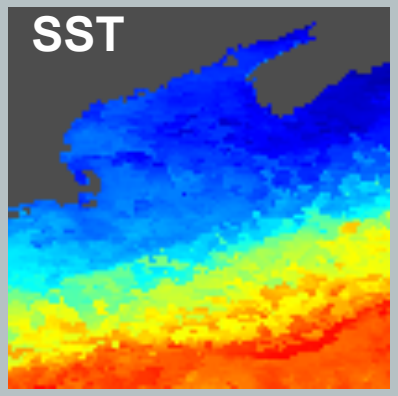

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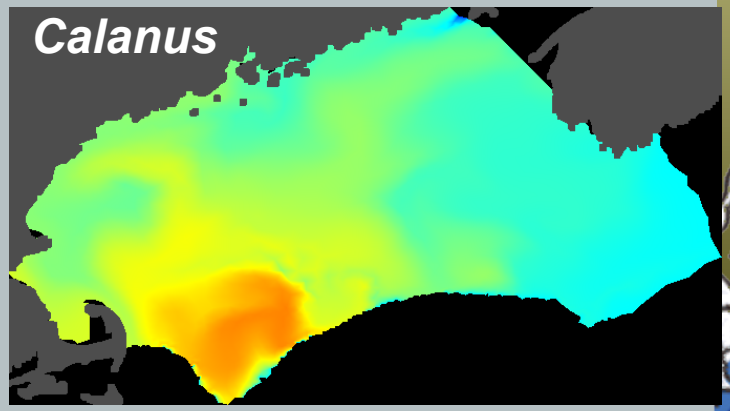

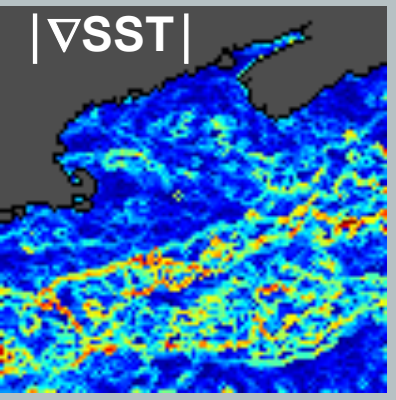

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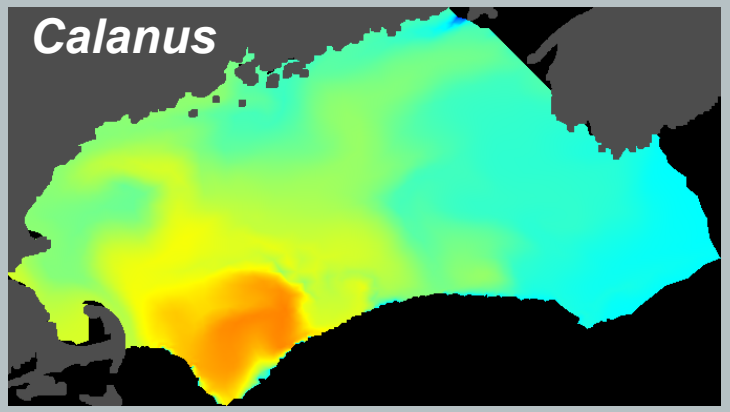

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Whale feeding areas

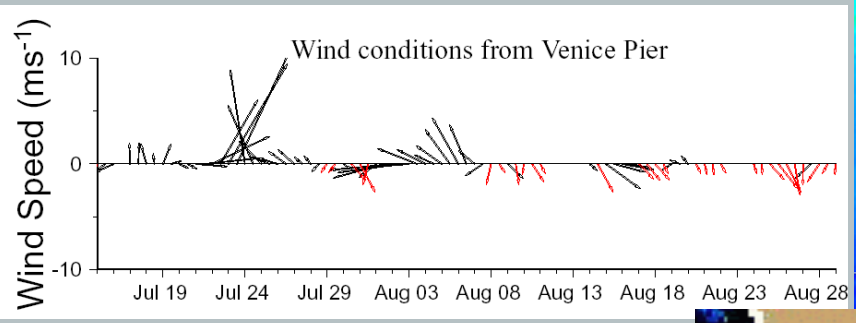
Ship strikes are biggest source of mortality to highly endangered (<400 left) Right Whales. Ability to predict their location will help NOAA minimize ship traffic in those regions.

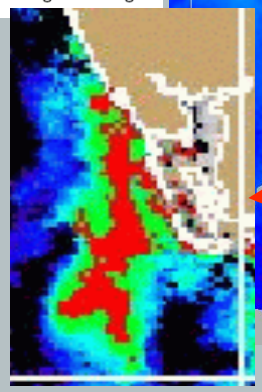
Pershing and Monger, Cornell University, funded by NOAA's Right Whale Grants Program

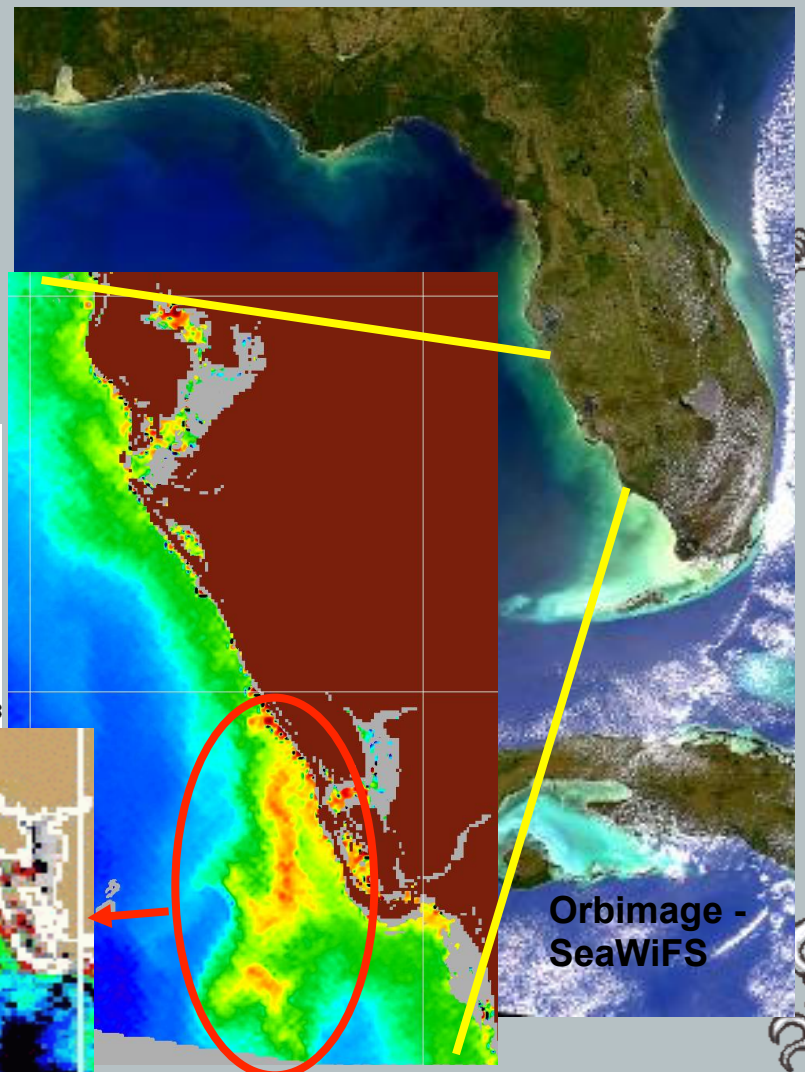
Harmful Algal Bloom (HAB) detection

NOAA National Ocean Service

Operational Monitoring and Forecasting of HABs in the Gulf of Mexico





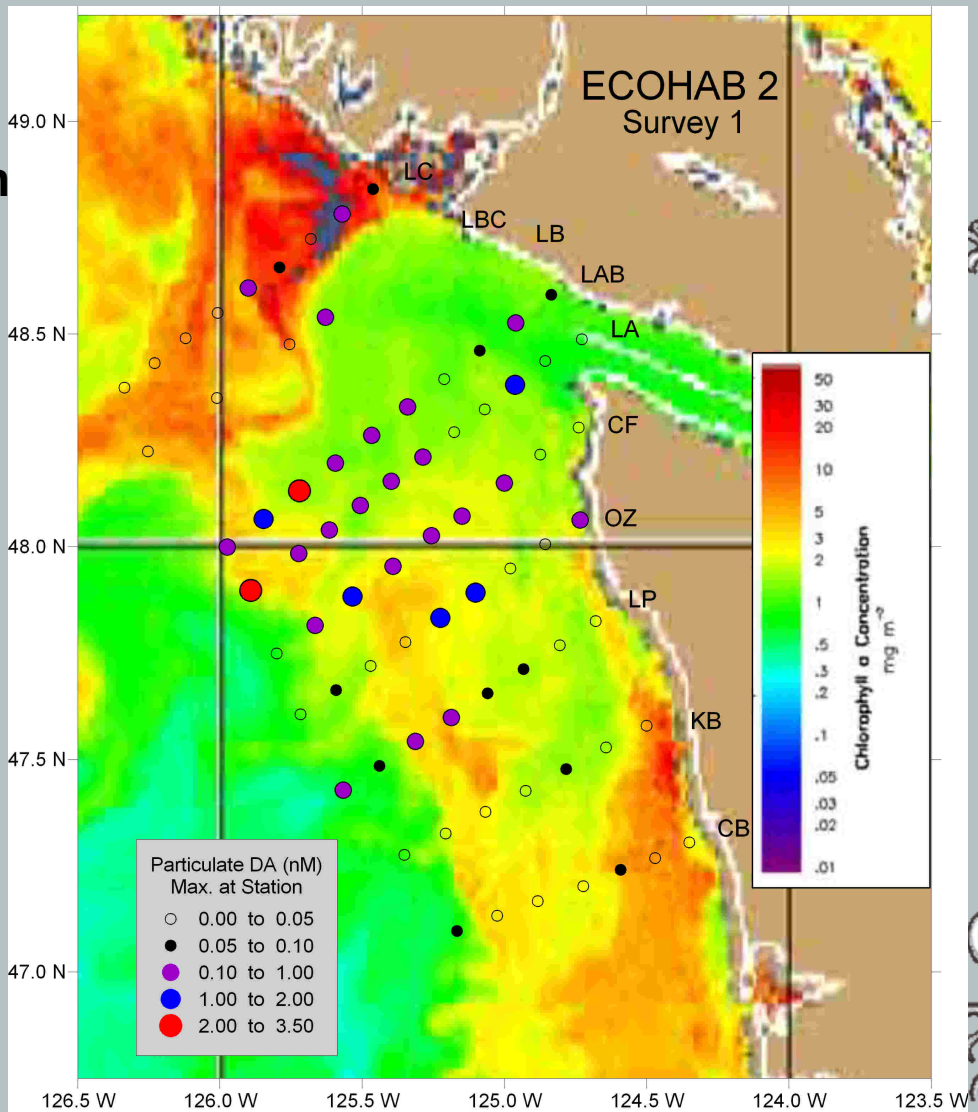


Courtesy of Rick Stumpf, NOS

Cruise Support

Domoic Acid levels (circles) measured during an ECOHAB survey, overlaid on top of satellite chlorophyll.

Satellite chlorophyll data is also crucial for monitoring development of harmful algal blooms (HABs).

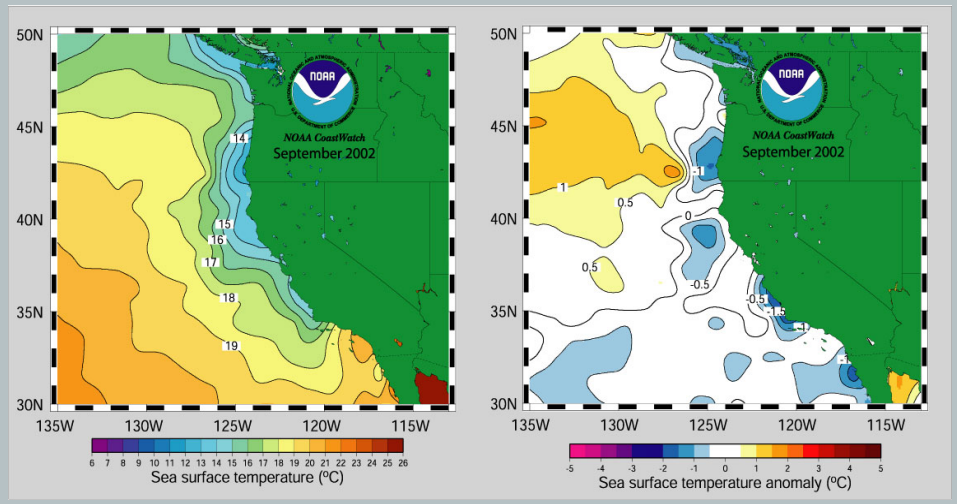


From Vera Trainer
NOAA/NMFS/NWFSC

Policy & Regulation

- On the east coast Coastwatch SST data is used by NMFS management to regulate operation of the flounder fishery and TED requirements in order to mitigate catch of endangered sea turtles

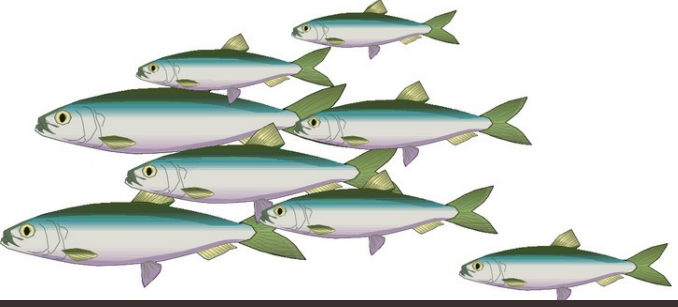
- Special SST data product is maintained by NOAA's West Coast CoastWatch node for NMFS SWR fishery managers, mandated for use in managing Calif. fishery to mitigate turtle by-catch



Question…

The high temporal and spatial resolution of satellite data, and its continuity, make satellite data an important tool for monitoring and characterizing marine ecosystems. Yet, the full potential of satellite data has not been realized within NMFS, or within fisheries science more generally.

Why is satellite data underutilized within NMFS, and what can be done to take advantage of the wealth of information this data can provide?



Some History

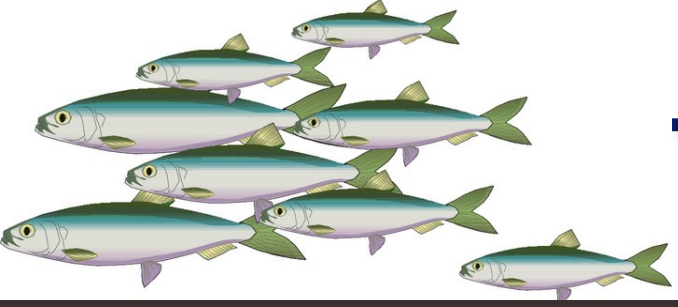
1996 ***Changing Oceans and Changing Fisheries: Environmental Data for Fisheries Research and Management*** **workshop at PFEL (SWFSC).**

2002 **Establishment of FATE, "Fisheries and the Environment" Program.**

2003 ***Building Environmentally Explicit Stock Assessments*** **workshop at Asilomar (sponsored by PFEL).**

2005 **Fisheries involvement in NOAA's satellite R&O (Research & Operations) program led to the establishment of NMFS satellite working group**

2006 ***Integrating Satellite Data Products into Ecosystem-Based Management of Living Marine Resources*** **workshop at MBARI, jointly sponsored by NASA and NOAA**



Ten Years Ago…

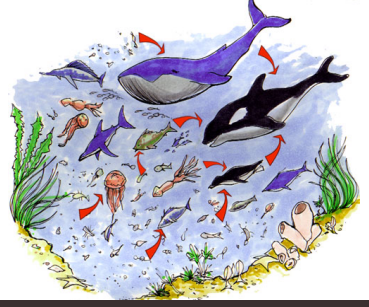
Changing Oceans and Changing Fisheries: Environmental Data for Fisheries Research and Management

Workshop held at PFEL July 16-18, 1996*

Copies of the workshop report available here, and on the web at

http://www.pfel.noaa.gov/events/workshops/env_data_1996

***now Environmental Research Division (ERD)**



Recommendations from 1996 workshop

48 specific recommendations
5 general themes:

1) Develop base-line climatologies of important environmental parameters to be able to place current conditions in a historical context
2) Apply new data technologies to fisheries
3) Improve communication and expertise across disciplines, NOAA, and other agencies
4) Demonstrate the benefits of applying environmental data in fisheries
5) Improve data accessibility for fisheries scientists

From 1996 workshop report, pgs 116-120

NMFS R&O FY05 Funded Project

Facilitate access to multiple satellite data sets to meet fisheries & IOOS needs

Three primary results:

- Establishment of internal NMFS-satellite working group
- A series of informational seminars given at all 6 Fisheries Science Centers during the summer of 2005 (and continued into 2006…)
- Access provided to global time-series of satellite-derived primary productivity, SSH and geostrophic currents via new Coastwatch West Coast Data Browser, the Oceanwatch Live Access Server (LAS) and by OPeNDAP technology at NOAA/NMFS/SWFSC/ERD